

Online supplement for: “Low body mass index is associated with higher odds of COPD and lower lung function in low- and middle-income countries”

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Table E1: Two-by-two contingency tables of the association between having BMI < 19.8 kg/m² and COPD when using the Global Lung Function Initiative 2012 Mixed Ethnic reference population. Fisher exact odds ratios (OR) and 95% confidence interval calculations were calculated per site, while the overall estimate and 95% confidence interval was calculated using the Cochran-Mantel-Haenszel (MH) chi-squared test. COPD was defined as having FEV₁/FVC ≤ 5th percentile (lower limit of normal) based on the Global Lung Function Initiative 2012 mixed ethnic reference populations.

Site	BMI < 19.8 kg/m ² , COPD –ve	BMI < 19.8 kg/m ² , COPD +ve	BMI ≥ 19.8 kg/m ² , COPD –ve	BMI ≥ 19.8 kg/m ² , COPD +ve	Fisher exact OR	Exact 95% CI
Bariloche	22	5	999	73	3.11	(0.89, 8.74)
Canelones	11	12	761	67	12.3	(4.77, 32.1)
Dhaka	213	61	1,297	101	3.67	(2.54, 5.28)
Kampala	57	4	529	6	6.15	(1.24, 26.8)
Lima	6	3	935	53	8.77	(1.38, 42.47)
Marcos Paz	12	5	1,053	166	2.64	(0.72, 8.18)
Masindi	72	16	278	48	1.29	(0.64, 2.47)
Matlab	682	186	863	93	2.53	(1.92, 3.35)
Nakaseke	86	17	582	36	3.19	(1.61, 6.13)
Rural Puno	18	6	438	38	3.83	(1.17, 10.8)
Temuco	10	2	974	52	3.74	(0.39, 18.2)
Tumbes	16	2	913	14	8.10	(0.83, 40.2)
Urban Puno	8	1	470	24	2.44	(0.05, 19.5)

Table E2: Two-by-two contingency tables of the association between having BMI < 19.8 kg/m² and COPD when using the Global Lung Function Initiative 2012 Caucasian reference population. Fisher exact odds ratios (OR) and 95% confidence interval calculations were calculated per site, while the overall estimate and 95% confidence interval was calculated using the Cochran-Mantel-Haenszel (MH) chi-squared test. COPD was defined as having FEV₁/FVC ≤ 5th percentile (lower limit of normal) based on the Global Lung Function Initiative 2012 mixed ethnic reference populations.

Site	BMI < 19.8 kg/m ² , COPD -ve	BMI < 19.8 kg/m ² , COPD +ve	BMI ≥ 19.8 kg/m ² , COPD -ve	BMI ≥ 19.8 kg/m ² , COPD +ve	Fisher exact OR	Exact 95% CI
Bariloche	23	4	1,019	53	3.34	(0.81, 10.3)
Canelones	13	10	771	57	10.3	(3.88, 26.8)
Dhaka	217	57	1,308	90	3.81	(2.6, 5.55)
Kampala	57	4	530	5	7.39	(1.42, 35.5)
Lima	7	2	953	35	7.74	(0.76, 42.7)
Marcos Paz	12	5	1,083	136	3.31	(0.9, 10.3)
Masindi	77	11	290	36	1.15	(0.5, 2.44)
Matlab	699	169	874	82	2.58	(1.93, 3.46)
Nakaseke	89	14	589	29	3.19	(1.5, 6.52)
Rural Puno	19	5	453	23	5.15	(1.38, 16.0)
Temuco	10	2	987	39	5.04	(0.52, 24.9)
Tumbes	16	2	921	6	18.9	(1.74, 117)
Urban Puno	8	1	475	19	3.11	(0.07, 25.3)

Table E3: Odds ratios of having COPD for different risk factors. Multivariable logistic regression was used to calculate adjusted odds ratios. This is a single model using the WHO BMI categories with normal weight (18.5-24.9 kg/m²) as the reference.

Variable	OR	95% CI
BMI ≥30 vs. 18.5-24.9 kg/m ²	0.56	0.45 - 0.71
BMI 25-29.9 vs. 18.5-24.9 kg/m ²	0.75	0.67 - 0.84
BMI <18.5 vs. 18.5-24.9 kg/m ²	2.13	1.81 - 2.51
Women vs. Men	0.81	0.49 - 1.33
Age in years	1.03	1.02 - 1.04
Daily smoking	2.22	1.86 - 2.64
Biomass fuel as the primary source for cooking	1.41	1.19 - 1.69
Completed secondary education or higher	0.88	0.70 - 1.10
Post-treatment pulmonary tuberculosis	3.62	2.75 - 4.76

Table E4: Odds ratios (OR) for having COPD among participants with BMI < 19.8 kg/m² when compared to those with BMI ≥ 19.8 kg/m², stratified by which site was left out of the analysis. The alternating logistic regressions (ALR) approach was used to calculate adjusted odds ratios accounting for clustering and Cochran-Mantel-Haenszel (MH) chi-squared tests for count data were used to calculate the common odds ratio to investigate the possibility of a single site having heavy influence on the overall primary outcome. ALR models were adjusted for age, sex, daily cigarette smoking, biomass, previous pulmonary tuberculosis and secondary education.

Site removed	OR _{ALR}	95% CI	OR _{MH}	95% CI
Bariloche	2.27	1.82 - 2.84	2.89	2.42 - 3.45
Canelones	2.16	1.82 - 2.55	2.77	2.32 - 3.31
Dhaka	2.24	1.73 - 2.90	2.71	2.22 - 3.31
Kampala	2.28	1.83 - 2.84	2.87	2.40 - 3.42
Lima	2.26	1.81 - 2.81	2.87	2.40 - 3.42
Marcos Paz	2.28	1.80 - 2.90	2.90	2.43 - 3.46
Masindi	2.41	1.86 - 3.12	3.12	2.60 - 3.75
Matlab	2.54	1.90 - 3.40	3.28	2.62 - 4.10
Nakaseke	2.30	1.80 - 2.95	2.87	2.40 - 3.45
Rural Puno	2.26	1.80 - 2.85	2.88	2.41 - 3.43
Temuco	2.25	1.81 - 2.81	2.89	2.42 - 3.44
Tumbes	2.26	1.83 - 2.79	2.88	2.41 - 3.43
Urban Puno	2.29	1.82 - 2.87	2.90	2.43 - 3.45

Table E5: Site-specific odds ratios for having COPD among participants with BMI < 19.8 kg/m² compared to those with BMI ≥ 19.8 kg/m². Multivariable logistic regression was used to calculate adjusted odds ratios. All models were adjusted for age, sex, daily cigarette smoking, biomass, previous pulmonary tuberculosis and secondary education.

Site	OR	95% CI
Canelones	9.21	3.74 - 22.7
Lima	7.56	1.72 - 33.3
Matlab	1.84	1.38 - 2.45
Dhaka	1.91	1.28 - 2.84
Tumbes	6.50	1.26 - 33.4
Bariloche	3.41	1.16 - 9.98
Kampala	4.61	1.09 - 19.5
Rural Puno	2.96	1.08 - 8.17
Nakaseke	2.10	1.06 - 4.16
Marcos Paz	2.37	0.74 - 7.61
Masindi	1.15	0.60 - 2.19
Temuco	2.07	0.35 - 12.1
Urban Puno	3.03	0.30 - 30.8

Figure E1: Body mass index categories vs. prevalence of COPD, stratified by sex. Body mass index categories were calculated per World Health Organization guidelines as underweight ($<18.5 \text{ kg/m}^2$), normal ($18.5\text{-}25 \text{ kg/m}^2$), overweight ($25\text{-}30 \text{ kg/m}^2$), and obese ($30+ \text{ kg/m}^2$).

Figure E2: Body mass index (BMI) cutoff vs. area under receiver operating curve (AUC) at each cutoff point used. Estimates were calculated by defining the BMI cutoff, fitting an adjusted logistic mixed-effects model with intercept by site and COPD as the outcome, and then calculating the corresponding AUC using predicted probabilities from said model. Cutoffs were made in 0.05 kg/m^2 increments between the range of 18 to 25 kg/m^2 . All models were adjusted for age, sex, daily cigarette smoking, level of education completed, and previous pulmonary tuberculosis. A smoothed line with 95% CI was fitted to the resulting AUC points using local polynomial regression fitting.

Figure E3: Body mass index vs. pre-bronchodilator fitted values for FEV₁, FVC, and FEV₁/FVC z-scores. Overall and stratified by site. The solid black lines represent the fitted values curves while the diamonds represent the crude binned estimates. Fitted values were calculated from individual models for FEV₁, FVC, and FEV₁/FVC z-scores. The overall curves were plotted along with the site-specific deviations (random effects) for comparison with crude binned estimates (diamonds). The three regression models (i.e. FEV₁, FVC, and FEV₁/FVC z-scores) were adjusted for age, sex, daily cigarette smoking, level of education completed, and previous pulmonary tuberculosis.

Figure E4: Body mass index (BMI) cutoff vs. normalized mean squared error (nMSE) at each cutoff point used, stratified by including COPD positive participants (left facet) and excluding COPD positive participants (right facet). Estimates were calculated by defining the BMI cutoff, fitting an adjusted linear mixed-effects model with intercept by site and FEV₁/FVC as the outcome, and then calculating the corresponding nMSE using predicted values from said model. Cutoffs were made in 0.05 kg/m^2 increments between the range of 18 to 25 kg/m^2 . All models were adjusted for age, sex, daily cigarette smoking, level of education completed, and previous pulmonary tuberculosis. A smoothed line with 95% CI was fitted to the resulting nMSE points using local polynomial regression fitting.

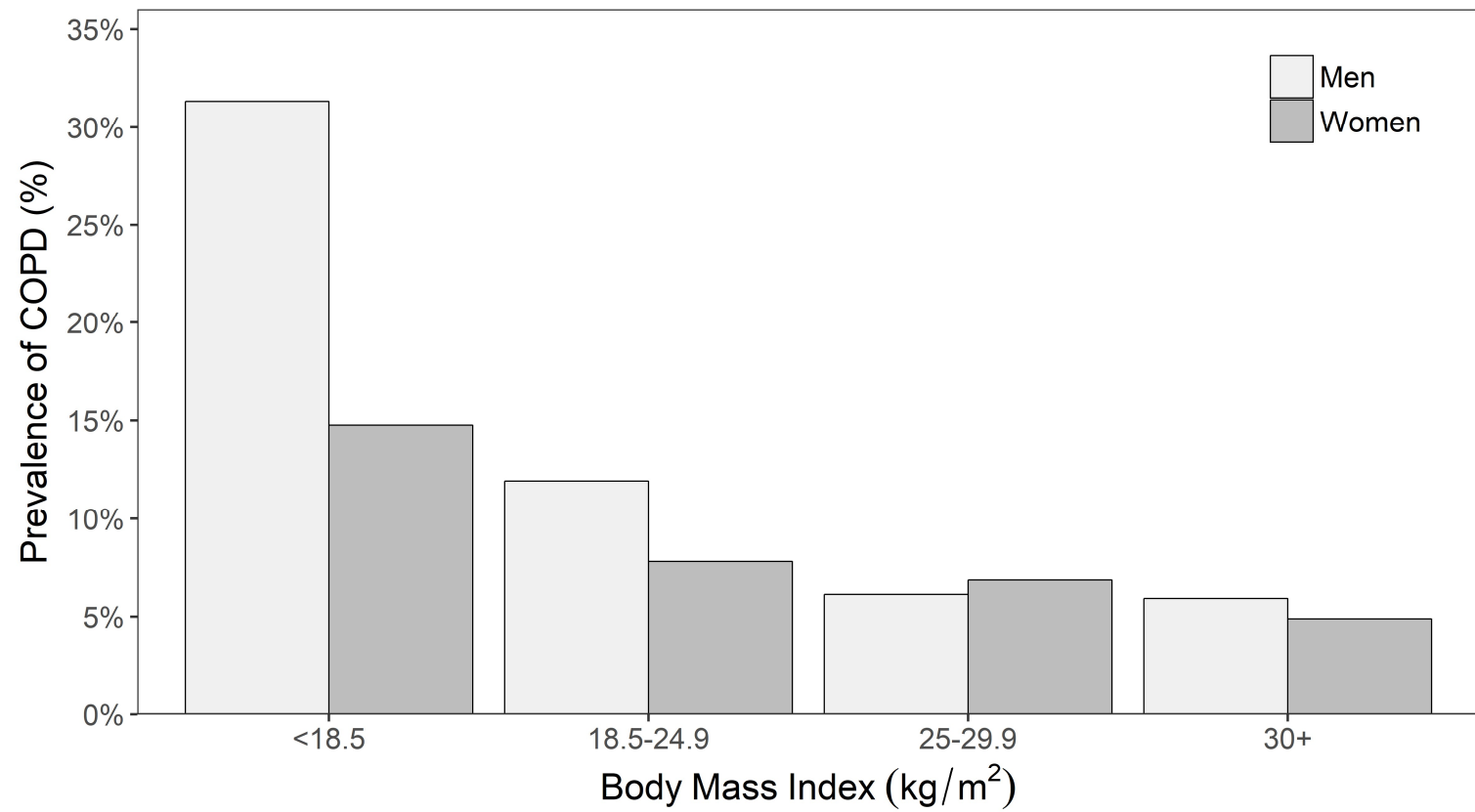


Figure E1

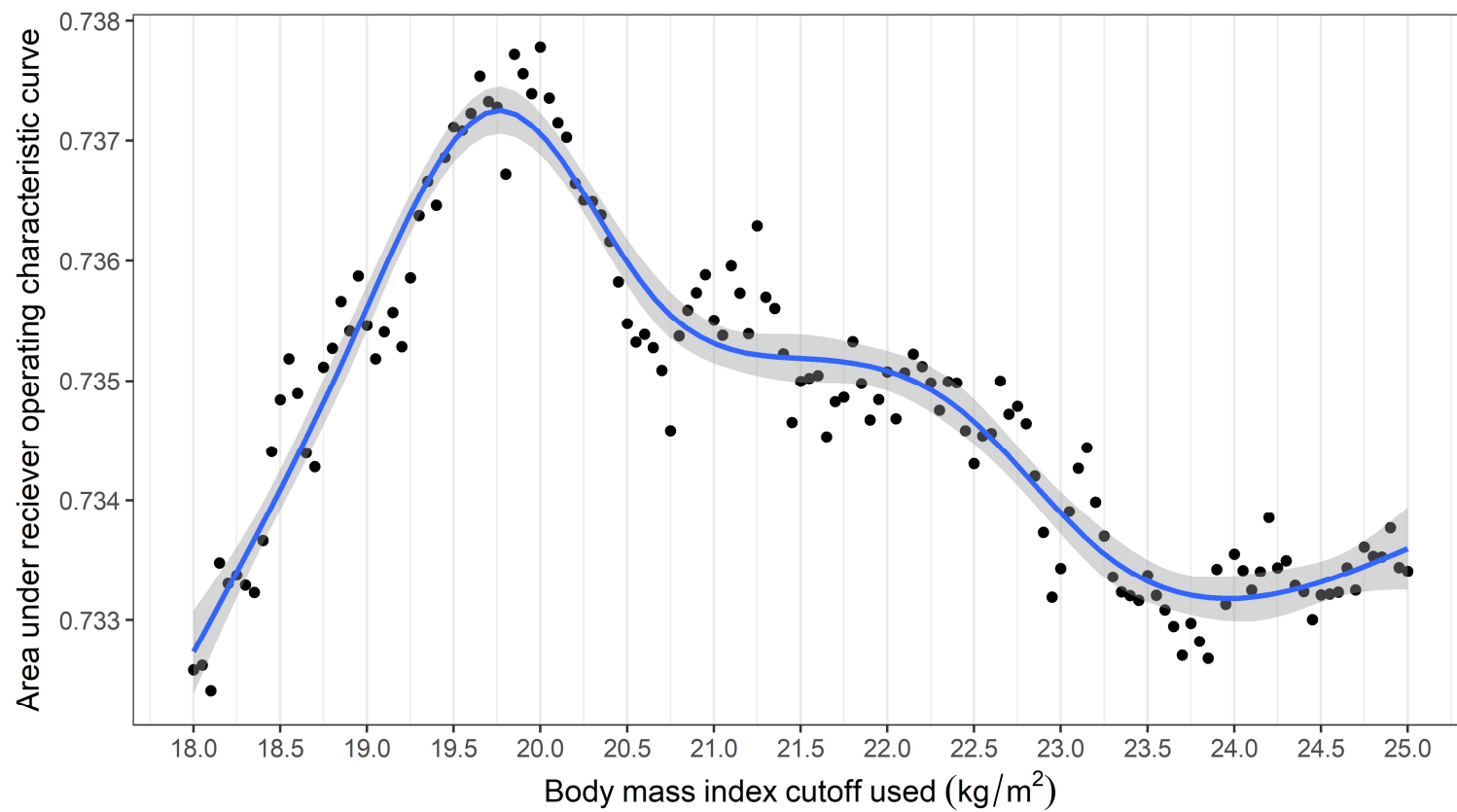


Figure E2

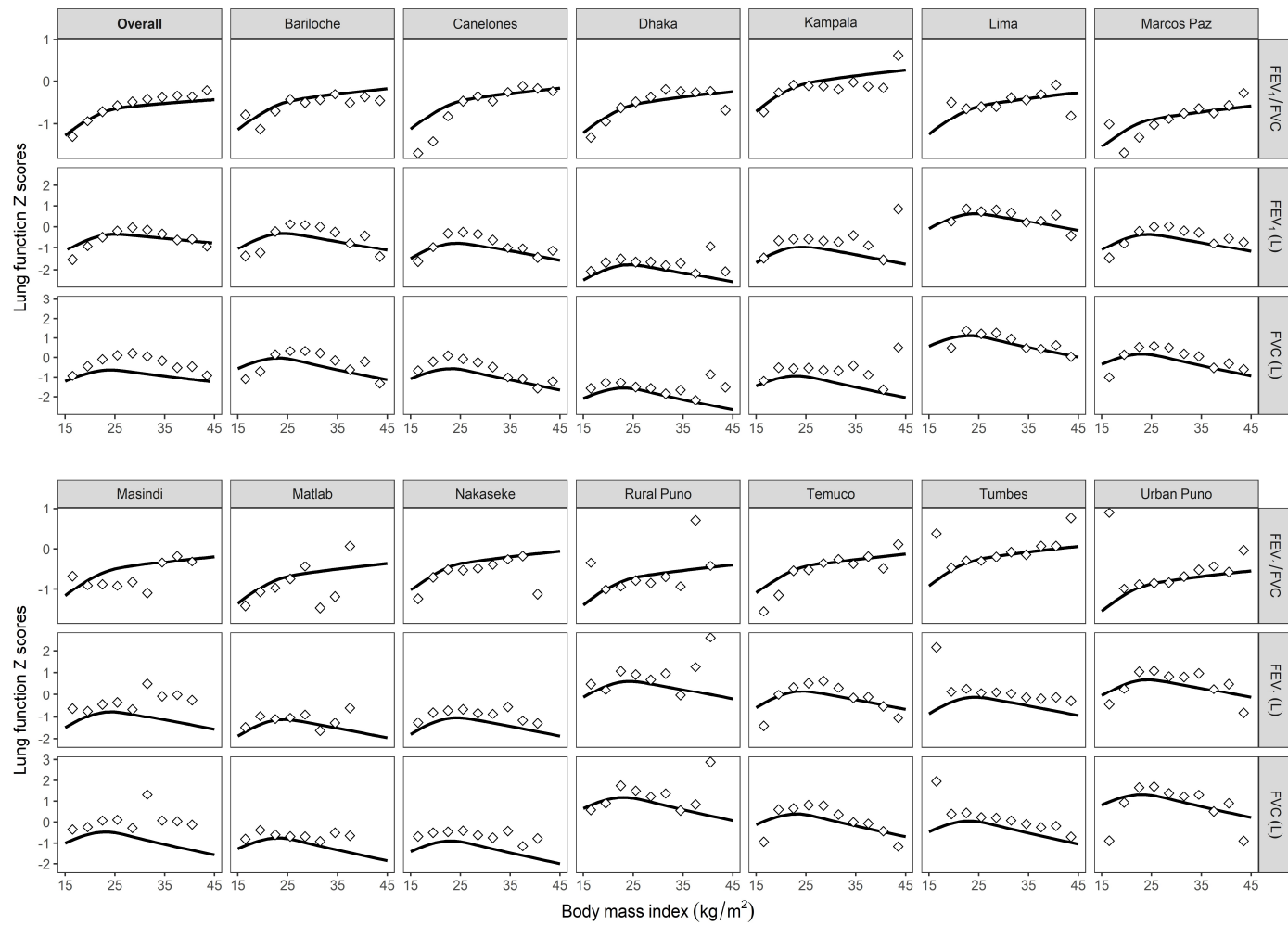


Figure E3

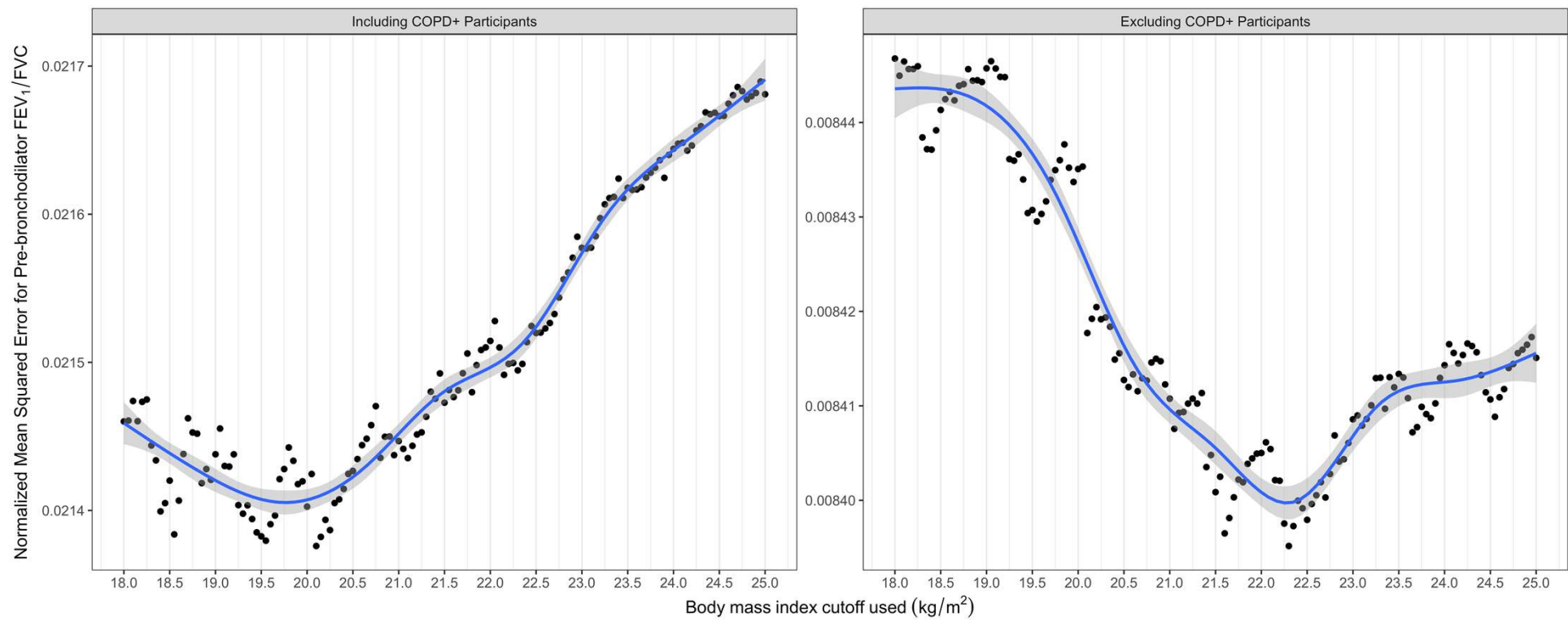


Figure E4